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Serial No. 09/849,768	Date: June 5th, 2006
Date Filed: 5/4/2001	Examiner: Pechhold, Alexandra
Applicant: K. Krueger et al	Group: 3671
Title: Stormwater Management System	Attorney No. STT-0003 (2307)

DECLARATION

1. I, John Battye, hold a bachelor of engineering degree and a master of science degree in operations management. I have about 20 years engineering experience. I have been doing finite element structural analyses for about 10 years. I am presently an analytical engineer with a major aircraft engine manufacturing company. I make this declaration in connection with patent application serial number 09/849,768 of Krueger et al., at the request of Infiltrator Systems, Inc. ("ISI"). I was an employee of ISI until 2004 and am very familiar with stormwater chambers and leaching chambers.

2. An arch shape cross section plastic chamber described in the present application has a truncated semi-elliptical arch shape curve cross section. That is, the arch shape of its cross section is less than half of an ellipse cut along the length of the major axis. Here, I call that kind of chamber "TSE chamber" (Truncated Semi-Elliptical chamber). The TSE chamber shape is a continuous curve chamber and, I understand, is the claimed invention.

3. Earlier thermoplastic chambers of ISI and some competitors had opposing sidewalls which were inward-sloping planes, connected by a curved top. They may be described as having a nominal trapezoidal cross section. Fig. 1 of both Pat. No. 4,759,661 and 5,511,903 show such shapes. The planar side wall enabled constant dimension slots in the sidewall (important for leaching use, but not for stormwater use).

4. A continuous curve chamber, such as the TSE chamber, is inherently stronger than a trapezoid cross section chambers of comparable weight per unit length. A stress concentration which arises at the abrupt curve slope change (called a "discontinuity") between a planar wall and curved top. In the trapezoid chamber, internal ribbing was necessarily used at the discontinuity, and even with that it still tended to remain a weak point. In the TSE chamber, such ribbing can be avoided because there is no discontinuity.

5. The major function of stormwater chambers is to store storm water beneath the surface of the earth so it can later percolate away. Stormwater chambers are installed by placing parallel adjacent rows of chambers on a flat crushed stone surface. They are then covered over with crushed stone. Other permeable media may be used, instead of stone.

Generally, the surrounding material is referred to as "soil". A chamber must resist the downward and sideward force of the weight of overlying soil, and in addition the transmitted load of vehicles and other things such as may be present on an overlying parking lot surface. In summary, in its basic function a stormwater chamber must be good at storing water and resisting loads. Obviously, cost is a consideration, and thus material and manufacturing and shipping cost are important.

6. Stormwater chambers driven by the foregoing factors. For economic shipping, chambers have to nest well, one within the other. Any chamber having vertical sidewalls is to be avoided, since those portions will not nest within one another at all. The outer portions of a semi-circle chamber or a semi-ellipse chamber, near the base flange, become virtually vertical. Thus semi-circle chambers do not nest well; the interference at the base flange location ends keeps the tops spaced apart a distance H, as illustrated in the enclosed Fig. 2. By contrast, a parabola chamber (chamber P below) and a TSE chamber nest well and the tops lie in close proximity. The TSE chamber works well because the near-vertical sides of a semi-ellipse, at the base of the chamber, are not present.

7. I have done numerous Finite Element Analyses (FEA) of thermoplastic (e.g., poly-propylene) chambers which have different arch shape cross sections and other dimensions. I have compared the capabilities of different design chambers for resisting soil loads during use by determining the stress distribution, distortion (strain) and predicted failure points. It is an aim to have the chamber withstand the design loads. As mentioned above, the stress concentration which occurs at the curve discontinuity of a trapezoid chamber means that reinforcement (ribbing) has to be provided within the chamber. That both increases weight and decreases the ability of chambers to nest.

8. I have also done other engineering analyses of chambers, including: making calculations which indicate the amount of water which a unit length of chamber can store; and calculating the amount of plastic material which it takes to make a chamber. For any given length of chamber, storage volume is a direct function of the cross section area within the curve of the arch. It is an aim to maximize that parameter. The amount of plastic, or chamber weight per unit length, is directly related to the length of the arch curve for any given thickness. It is an aim to minimize the amount of plastic in the chamber.

9. Fig. 1 illustrates the comparative cross section shapes of four different arch shape cross section chambers, namely TSE (truncated semi-ellipse -- a chamber of the present invention), SE (semi-ellipse), P (parabola) and S (semi-circle). Table 1 compares the properties of chambers illustrated in Fig. 1. Each chamber has a width of 45.2 inches at the base and a height of 29.6 inches, to fit within desired rectangle R, except for S for which it is not possible to obtain the desired height. The dimensions used in this analysis are approximately representative of an actual commercial chamber. My statements and conclusions here will apply to other dimension chambers.

10. In Table 1 comparisons on a percentage basis are made first using the semi-circle S as the reference, and second, using the TSE as a reference.

Table 1 shows the substantial superiority in volume parameter of the TSE and SE over both S and P. TSE is approximately 15% better than P and 26% better than S. This is graphically evident in Fig. 1.

Table 1 shows TSE has an about 5% disadvantage in material parameter over P, and about 15% disadvantage over S. This can also be understood graphically from Fig. 1, by the length of each curve. (Of course, if we normalized the chamber volumes, by making the length of each chamber sufficient to provide the same volume, that increasing of length would require more material, in accord with the volume parameter difference.)

Of course, as pointed out both S and SE have the further disadvantage of not nesting well.

11. TSE is substantially better than the other choices as a storm water chamber because it provides nearly the highest volume per unit length, good nesting and a small material cost disadvantage. No other continuous curve chamber provides the same combination of advantages.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

John Battye

John Battye

June 5th, 2006

Date